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Experts in Organizations

A Knowledge-Based Perspective
on Organizational Change

Translated by Liz Libbrecht



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Introduction

Falsity consists in the privation of knowledge, which inadequate, that is to say, mutilated and confused ideas involve (Spinoza, *Ethics III*, prop. 35).

What will be the shape of firms in the twenty-first century? Will they be “inverted pyramids”¹ with only the simplest of hierarchical structures? Will tomorrow’s organization charts describe, not services, but rather networks of actors transformed into just as many individual companies? Are firms likely to evolve in the same way as community movements, driven by strong collective cultures or charismatic leadership? The formulae proposed over the past few years by certain management theorists² clearly indicate a renewed quest for the ideal firm, the “one best way” to prefigure the efficient enterprise of tomorrow. This prevalent concern with a mobilizing doctrine is all the more striking in that it contrasts with the main trend in the 1970s. At the time, the virtues of a certain relativism were put forth and the multiplicity of organizational forms was perceived as an adequate response to the diversity of situations. However, renewed interest in the “right model” should be taken seriously, for it may well be a symptom of the conceptual and practical difficulties experienced by many firms faced with the profound upheavals that have affected economic life during the past twenty years. The perpetual slump, the arrival of new competitors, or the instability of markets have eroded many certainties and spawned a number of new doctrines. This need for a model is understandable when transformations with multiple and uncertain impacts have to be undertaken in a threatening and difficult environment. It provides guidelines and can at least be compared to the contrasting model that is henceforth, and sometimes too habitually, constituted by the so-called Taylorian or bureaucratic firm.

In imagining the evolution of firms or that of their operation we are perhaps as much at a loss as an observer in the 1880s trying to forecast the shape of the twentieth century economy. Having witnessed, like us, a long economic slump, a proliferation of new technologies (including the automobile and electricity) and the emergence of new powers (Germany and the United States), he or she would probably have imagined neither Taylorism, nor the monthly payment of salaries, nor marketing departments. In many respects the transformations in economic life that we are witnessing today are a reminder, in their intensity and their extent (proportionately speaking), of those at the end of the nineteenth century. We must therefore agree that an exercise in forecasting is somewhat futile, in spite of our convic-

1 In J. Carlzon’s words (1986).

2 This movement was initiated by Peters and Waterman’s book on the most efficient American firms. In France the same theme is found in the work of Archier and Sérieyx (1983). A synthesis of these different doctrines is presented by Aktouf O. (1989).

tion that future upheavals may well be even more profound than those which we have already experienced and that we must be prepared for them. These remarks leave few options for thought; *in particular they are an invitation to understand those trends which in current situations generate new questions and tensions, and those which are only emerging, by outlining the dominant questions of tomorrow's firms.*

Rather than finding the model of an ideal firm (and we cannot say in what way it would be more efficient or better), we need to detect the problems that will convey the most important stakes and to which future firms, in order to be viable, will have to respond. *It is around these problems that the improvements to be made, the resources to be used and the organizations to be invented, will be defined.* Firms will of course always have to deal with decision making or financial issues, they will always have to choose and to motivate their employees in one way or another and to wonder about whether they should apply rules or give autonomy to the different actors, but the permanent nature of these problems hides a more essential reality. Each period and each context gives particular weight and content to one or another of these questions.

The development at the beginning of the 1980s of various forms of worker participation and involvement (e.g. progress groups and quality circles) can therefore hardly be explained if we think only in terms of employers' failure up until then to take an interest in their workers' abilities. It is only by looking at the new problems and specific historical context which made this participation relevant, that one can say whether there really was what we call *rationalization*, in other words, increased efficiency or – what amounts to the same thing – a solution for some organizational crises. Worker involvement was not merely a response to an intensified need for autonomy felt throughout society; it was also a means of counteracting the *compartmentalization of expertise* that had become dangerous in an economy oriented towards permanent innovation and the proliferation of products. For if we lived in an industrial world that was perfectly controlled by its designers or that incessantly repeated the same routines, what would be the use of motivating its operators to carry out a permanent search for defects and dysfunctions. What would be the use of the urgent demand for their initiatives? Behind these sometimes spectacular new forms of work lies the emergence of a series of problems concerning not only the structure of industrial firms or their decision making processes but also, more profoundly, the dynamics of the expertise which keeps economic entities alive.

The research presented here, although devoted to the development of expert systems in industrial firms, is the outcome of such analysis and therefore of *the hypothesis that, in an economy where product variety and innovation are vital, expertise necessarily constitutes a new and favoured field of rationalization.*

1 Expertise faced with diversity

The question of expertise itself is by no means new; firms are constantly preoccupied with procuring required skills through recruitment³ or training. However, the significance of these problems has become apparent on a global scale where it involves national industrial and technological policies⁴. On a corporate level it naturally involves the stakes linked to research and development, the control of strategic processes, and the problems raised by the accelerated renewal of products and markets. The latter might only have had limited consequences, had this renewal not been accompanied by the increasing complexity of goods and services in the most advanced economies. The number of optional extras and variations of manufactured products has become infinite and it is becoming clear that a “good product” cannot be identified by its price, qualities, image, after-sales service or delivery lead time alone, but by a variable combination of all these attributes. In order to define current issues, the two notions of renewal and complexity must therefore be inseparably linked; in other words, the name of the game must be “variety economy”⁵, with this term taken in its fullest sense, i.e. meaning the multiplication of types and the constant creation of new variations of products in any firm.

What then are the consequences of such complexity and how do firms react to it? Besides the employee involvement mentioned above, the current emphasis on training is a significant type of response to this destabilization. The number of innovative experiments in this field has multiplied, which also points to the importance of the stakes and probably – according to recent research – to the creation of new expectations in employees and management alike⁶.

A different type of approach was initiated concurrently in the 1980s with the development of expert systems. The innovation was a particularly ambitious one in so far as it aimed for improved control and diffusion of knowledge, and in that it

3 The international circulation of artists or craftsmen is as old as civilization itself. Examples akin to our current preoccupations can easily be found in the early nineteenth century when companies turned to England for specialists in the construction of industrial machines.

4 On this subject see Dosi G. et al. (1988); Cohen E. (1989).

5 The concept of variety is narrowly linked to the more common concept of flexibility; however, in this work variety means essentially product customization and innovation and can be grossly evaluated by the number of different final articles produced by the same production system; see Cohendet A. et al. (1988); Hatchuel (1988a).

6 See Riboud A. (1987); Dubar (1991). Spurred by the Japanese model, the movement towards work reform and new shop management was intense during the eighties. However, it focussed on shop workers and rarely analyzed the technical departments. The members of these departments will, by contrast, be the heroes of the expert system projects studied in this book.

inevitably implied the *institution of new relations between the experts themselves and the system in which their expertise was used*.

Before looking more closely at this approach, it may be useful to clarify the meaning given to the word *expertise*. Bearing in mind our general computer culture, it is important to specify that expertise is not an information system or a database and *that it comprises a set of theories and questions on which an activity can be based, or from which data can acquire meaning by generating new theories or questions*. Nor is expertise, by nature, a discipline or a science: it has not necessarily been developed systematically or subjected to academic control procedures; it can be constituted in a variety of ways and base its legitimacy on complex mechanisms (to be discussed below). Take, for example, a salesman who visits his clients in a particular region fairly regularly. He gathers facts, develops certainties, and constantly retains a series of doubts and questions. This living body of knowledge and questions is essential to his activity. Even if it is riddled with mistakes and short-cuts, or combines a number of facts, opinions, calculations and beliefs, it will still function for him, or for others, as expertise, in other words as a source of references and ideas, or an instrument of action and communication⁷. In corporate life, new expertise is constantly being created through the entire range of possible activities, from material processes to commercial or legal exchange, interpersonal relations or modes of organization. In short, the question of expertise in firms is clearly not limited to the fields generally referred to as technological.

2 Expertise as an object of management

Towards the end of the 1970s, artificial intelligence (AI) and more particularly its most prevalent branch, expert systems (ES), became a leading new technology that nourished numerous philosophical debates and heralded a new computer revolution. But above all, through it the idea of using computers to gather expertise on any subject domain became feasible. During the first half of the next decade, leading firms soon set the trend – some even boasted about their use of expert systems in their advertising messages – and a series of projects and experiments was launched. It was not that those firms which decided to build expert systems had suddenly discovered that their employees had *expertise*, but rather that it had suddenly become possible to preserve, update and distribute this expertise by means of computers. *Expert systems thus opened a new field of knowledge and action:*

7 This type of definition also helps to avoid the natural tendency of implicitly confusing knowledge and techniques and, more specifically, knowledge and techniques relating to matter or machines.

they turned expertise into the object of possible rationalization, into an object of management, in the same way, for example, that Taylorism had made of time and motion an object of investigation and control.

Were expert systems the best approach for rationalizing expertise? The limits of the project were indeed easy to define: who would have thought that the complexity of human knowledge or the learning capacities of homo sapiens could be found in a machine, even the most powerful? But this kind of limit has no sense when applied to corporate life⁸, an expert system containing even a small portion of knowledge may be economically adequate. No judgement could therefore be passed on the approach without a preliminary understanding of the dynamics of expertise in industrial firms, or without an idea of the possible changes and problems to which the restructuring and redistribution of this expertise might lead.

As surprising as it may seem, these questions did not play a significant part in reflection on corporate functioning. Research most often focussed on problems of structure, strategy and more recently culture; the study of actors' expertise was however spurred by problems concerning technological change⁹.

Admittedly, the subject does not lend itself very readily to investigation or observation, for a person's expertise is not something that is easily accessible. Although clues can be picked up in certain types of behaviour, the main elements constituting expertise may still escape analysis. *Expert systems, on the other hand, forced interested firms to undertake fundamental research on the knowledge held by some of their main actors. We therefore felt that this type of project, as much through its success as through its difficulties, provided a perfect opportunity for exploring the dynamics of expertise in organizations, precisely because it embodied a more extreme form of rationalization.*

8 From the beginning of the 1970s Hubert Dreyfus (Dreyfus H.L., Dreyfus S.E. 1986) attempted to demonstrate the limits of artificial intelligence. The debate initiated by him is not, however, directly relevant here, for knowing whether AI programmes will effectively culminate in a machine that "thinks", bears very little relation to the potentially industrial dimension of these approaches. On the other hand, these philosophical debates contributed to the "futurist" image of expert systems.

9 Mention must nevertheless be made of comparative studies on educational systems which looked at the impact of qualification systems on the organization of firms, even if they did not specify what form of knowledge is produced by these systems (Maurice M. et al. 1986).

3 Expert systems: a questionable development

In itself this conclusion might have led to the belief that expert system projects could provide instruments for research on expertise in firms, had there not been so many practical questions which remained unanswered by manuals and specialized reviews. What happened to the basic assumptions of expert systems in the field? At what expertise was the approach aimed? How could expertise be gathered in an organization? Since the advent of expert systems in the 1980s, certain specialized firms have clearly lost interest in them and a large number of projects have not advanced beyond the planning stages. Only very recently has an improvement in this situation been recorded by specialists in the field. There was thus a convergence of our interest in understanding the stakes involved in the rationalization of expertise, and the problems encountered by firms undertaking such projects. *It was this twofold interest which guided our research and the structure of this book.*

Most of the material used was taken directly from real projects whose development we monitored on an on-going basis. Four of these have been described and discussed in detail in Part Two; *they concern the automation of production routing in a precious metal industry, breakdown diagnosis of machining equipment in an advanced mechanical firm, the assignment of routes to trains in a large railway station, and finally the planning of exploration in an oil company.* The four projects were chosen amongst several others because they mobilized different types of knowledge and actors with differing status, but also because there was a genuine intention to make them operational. The study of their development, their crises, their options, and the organizational transformations associated with them, formed the basis of our analyses of the management of expertise in industrial firms – which also explains why this book comprises two main parts.

4 Two ways of dealing with the same material

Part One is devoted to the presentation of analyses and conclusions drawn from our research. The different projects are discussed concurrently, along a number of essential themes.

Part Two describes each project separately, along the main lines of a common thematic structure. It is not an annex, but is complementary to the first part and constitutes a more narrative and extensive presentation of the same material. Our intention was to offer readers direct and overall access to the projects studied, thereby allowing them to draw conclusions that differ from those based on our own assumptions, suggested in Part One. It is also a response to the need which

we encountered in many of our interlocutors, for greater detail on the technical, economic or social aspects of such projects. Such detail would have made the first part somewhat unwieldy, had it been included there.

To conclude this introduction with an overall view of the main arguments presented, we shall briefly summarize *the contents of the different chapters comprising the first part of the book*.

Chapter 1 presents the basic hypotheses on which expert systems are founded, as well as the methodology and analysis framework that we used.

Chapter 2 characterizes the expertise which served to develop the systems in the different projects studied. We see how the basic hypotheses of the approach had to be transgressed, because they described a very limiting form of expertise. Thus, although expert systems are defined by the imitation and harnessing of human knowledge, the success of projects necessitates the transformation, even the enhancement, of that knowledge. This restructuring of expertise can be the condition for automation, and is in itself already a process of rationalization. The transgression of the basic hypotheses of ES demonstrates the diversity of forms of expertise in action, diversity which we tried to condense by distinguishing three main types: that of the artisan, the repairer and the strategist.

Chapter 3 shows how the restructuring of expertise, which takes place during the course of the project, transforms relations between actors. This type of change goes beyond a mere modification of the powers or respective responsibilities of individuals; it leads, in certain cases, to what we shall call a metamorphosis of the actors, going as far as the birth or disappearance of some of them. The transformation of expertise implies a potential displacement not only of means for action, but also of the very definition of actors. It does not therefore amount to a mere game between predetermined actors. Some of its theoretical characteristics are outlined in this chapter.

Chapter 4 adopts a more historical perspective. We see that expert systems extend the rationalization process started at the end of the last century, whilst simultaneously renewing its objectives and approaches. They help us to better understand the nature of *management techniques*, in which they constitute the latest known trend. We show how each of these is composed of three structural elements: a technical substratum, a managerial philosophy and a simplified organizational model. But the scientific organization of work, operational research, new forms of flow management or expert systems, all make over-simplified assumptions on the conditions of collective action and must therefore be called into question. This counter-culture, because it illuminates the misunderstood aspects of corporate life, is an effective vehicle for efficiency and constitutes an integral part of the rationalization process.

Chapter 5 looks at the main industrial stakes revealed by expert system projects. *Production planners, station traffic planners or maintenance specialists whose expertise was elicited in the projects studied, are all products of Taylorism*. Artisans of its implementation and supported by it, they became part of industrial

firms at the start of the century, and there they invented the figure of a new actor who based his legitimacy on specific know-how and the position of a conceiver. The study of their expertise shows them caught between the figure of an engineer and that of a negotiator; it also reveals the heterogeneity of their knowledge, aggravated by the consequences of a variety economy found in all the situations studied. It is when living expertise, generated by uncontrolled accumulation by a small number of actors, has to be restructured that the main stakes of rationalization appear most clearly. Expert system projects thus help to reveal the hidden crises which may await these actors. They show us to what extent industrial firms are themselves faced with a crisis in their central expertise, since this expertise has to be restructured to respond to the complexity of the economic environment.

Like its predecessors, the expert system technology gives rise to a type of unexpected repercussion. It reminds us that organizations must be considered as systems of knowledge production – *a view that will be all the more useful if we are to experience the weakening of hierarchical or bureaucratic structures, in favour of more participatory horizontal processes. In order to understand new organizational forms, the knowledge systems of actors and the interaction which these allow must be taken into account.*

It is therefore hardly surprising that we have to revise our conception of corporate life if we want to understand the effects and dead ends of rationalization.

Part 1

Chapter 1

Exploring expertise

Objectives and materials of a study

We shall start with an imaginary outing and a little riddle. Invited by an industrial firm which could be qualified as modern, we are taken on a guided tour through a series of departments, ranging from planning to maintenance. Since industrial modernity is often – and usually rightly so – linked to computerization, it seems quite normal for us to see a number of people with their eyes glued to computer screens. Three of them are of particular interest to us, although nothing obvious distinguishes them from their colleagues. One, we are told (although we do not know who he is), uses a special kind of advanced, new generation computing system that is “intelligent” – an “expert system”!

Surprised and intrigued, we want to know more. The first person explains that he has to set his machine before starting it. By answering a list of questions proposed on the screen, he can define the desired characteristics of the part to be manufactured. In return the computer will calculate and provide the most suitable setting for the machine. The second person seems to operate with a broader perspective. He is busy with his weekly task of checking the overall production programme for the workshop, proposed by his production management software. In order to draw up this plan, the computer takes into account a large body of information from the sales department, research department, or workshops, which means that its proposals cannot easily be refused. However, the chance of it making a major error cannot be discounted, and the operator considers it wise to check the plan before approving it. The third person in our fictitious visit is clearly not as calm as his colleagues. The behaviour of one of the main facilities in the workshop has become a cause for concern; it is obvious that something is wrong, but what? Our man has some ideas, but needs confirmation, and he impatiently answers the multiple questions put to him by the computer program specially designed for diagnosing machine failures.

Would it possible, after such a visit, to say which of the three applications included the most “artificial intelligence”? Might one have the impression that diagnosing a failure required “expertise”, whereas setting a machine or drawing up a production programme did not? Of course not!

1 Expert systems: the attributes of an approach

Yet this is precisely the kind of judgement that the notions of artificial intelligence and expert systems (of which failure diagnosis is the most commonly referred-to application, although not the easiest to implement) have inspired during the past ten years or so. These notions have profoundly, but ambiguously, influenced our way of viewing the computerization of firms, starting with the most common terms that ordinary users have had to assimilate. The classical computer model which distinguishes “programs” and “data”, calculations and variables, has been replaced by the more complex structure of expert systems. Several new concepts have appeared, notably “knowledge bases”, “inference engines” and “fact bases”. Before defining them briefly, we must point out that these terms could well have represented mere refinements to existing computer language, or variations in the art of programming; had this been the case, expert systems and a good deal of artificial intelligence would never have had the repercussions we know them to have had these past few years. For beyond their technical contents, these expressions evoked from the outset a vast project and many problems which, carried by far more metaphorical meanings, led expert systems to rapid renown that exceeded the milieu of computer specialists.

Thus the definition usually given to expert systems, even in specialized manuals, immediately plunges one into imagery and allusion. They are described as computer programs aimed at “imitating human reasoning”, and whose development therefore necessitates the “extraction of expertise” from experts in a particular subject domain. It is the combination of a set of more or less recent computer techniques which use abstract logical formalism on the one hand, and a less specific discourse on knowledge, know-how or expertise on the other hand, which forms the peculiarity of the field of action progressively created by means of AI and expert systems. Without this combination, the concepts of “knowledge representation” or “imitation of human reasoning” would soon have lost their specificity and could have been claimed by any computer program, since they all involve some degree of knowledge. The three examples in our imaginary visit all require complex knowledge or expertise before being implemented, even if in practice two of them can function without the use of AI tools.

It was thus by going beyond common sense, with a narrow and formal approach to “knowledge” and “reasoning”, that expert systems were able to inaugurate a new field of thought and open the way to projects hitherto considered as unfeasible.